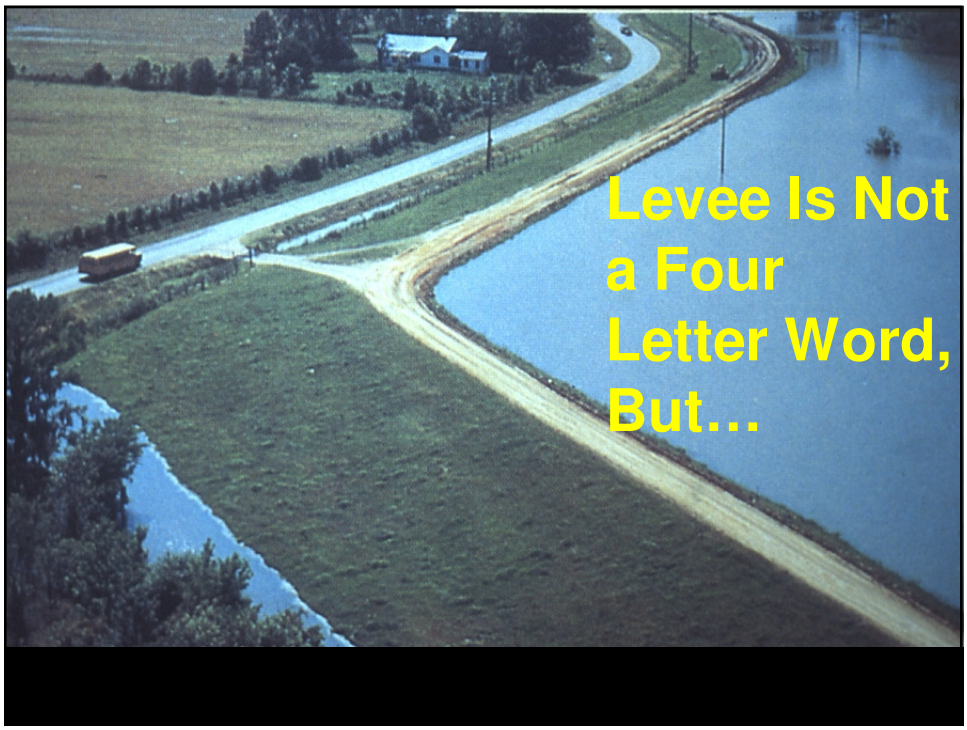
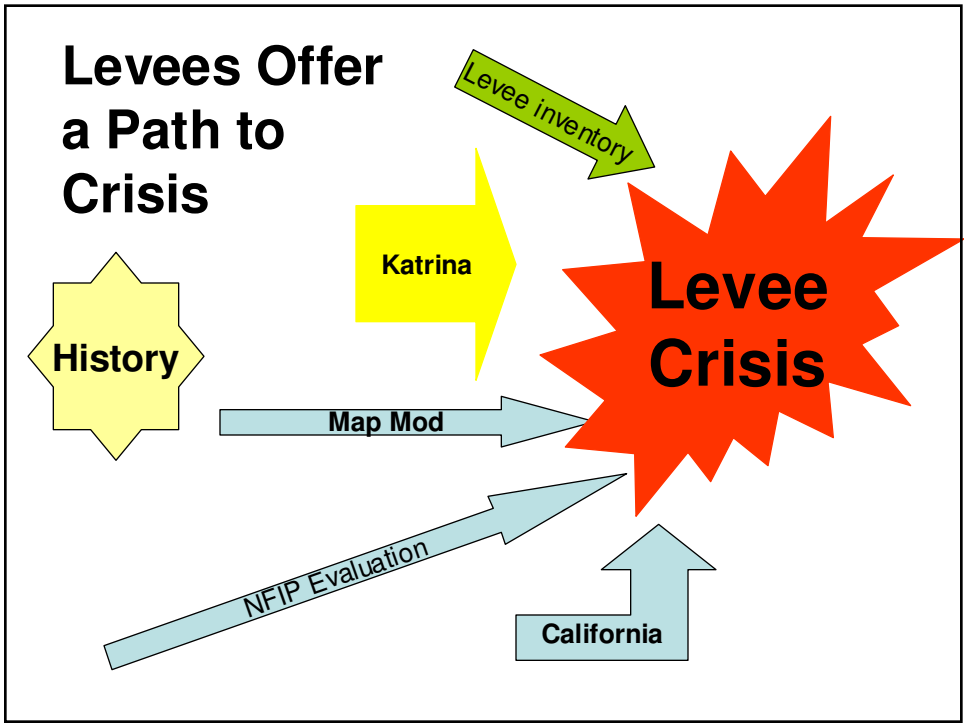
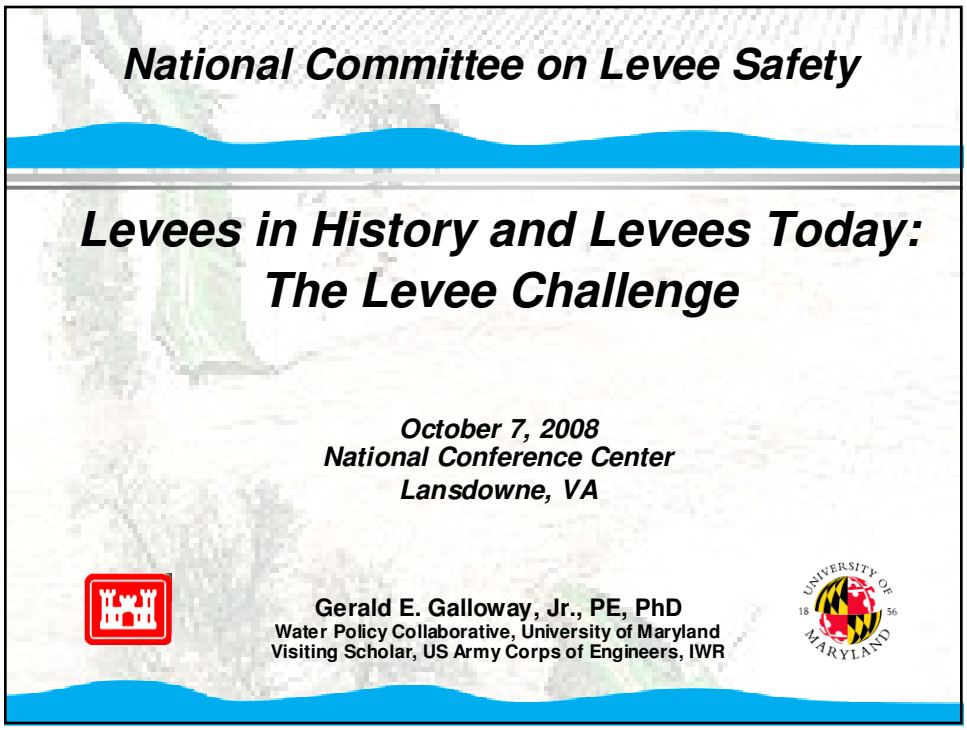

Levee Is Not
a Four
Letter Word,
But…


Levees Offer a Path to Crisis
Levee inventory
Katrina
History
Levee Crisis
Map Mod
NFIP Evaluation
California


National Committee on Levee Safety
Levees in History and Levees Today:
The Levee Challenge
October 7, 2008
National Conference Center
Lansdowne, VA
Gerald E. Galloway, Jr., PE, PhD
Water Policy Collaborative, University of Maryland
Visiting Scholar, US Army Corps of Engineers, IWR

Caution

THE SPEAKER DOES NOT REPRESENT ANYONE OR ANY AGENCY.

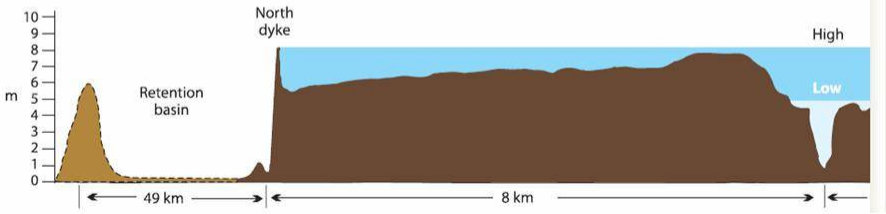
THE OPINIONS EXPRESSED ARE HIS OWN AND DO NOT REFLECT, NECESSARILY, THE POSITIONS THE UNIVERSITY OF MARYLAND, THE ARMY CORPS OF ENGINEERS OR ANYONE ELSE.

Fear the Turtle

Floods and the Need for Protection Have Been Around for a Long Time

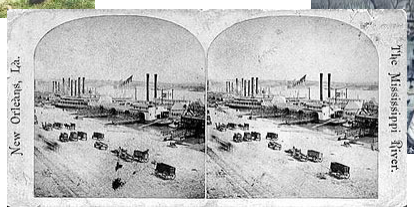
Civilizations Have Grown Around Water Infrastructure

FIGURE 2
Representative cross-section of the "suspended" Yellow River.



Mark Giordano, Zhongping Zhu, Ximing Cai, Shangqi Hong, Xuecheng Zhang and Yunpeng Xue After Ronan

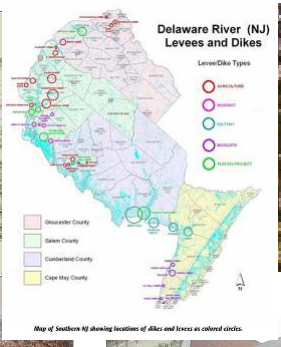
Floods and Levees Were Part of Early North American History



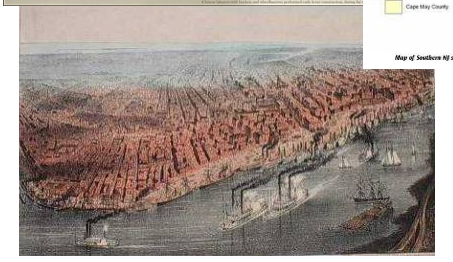
Levees Were a Key Method of Defense

Levee - "…a man-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding."

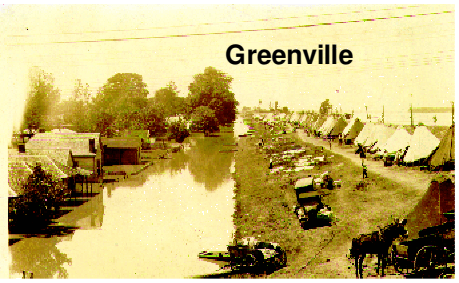
And People Tried to Deal with the Flood Challenge

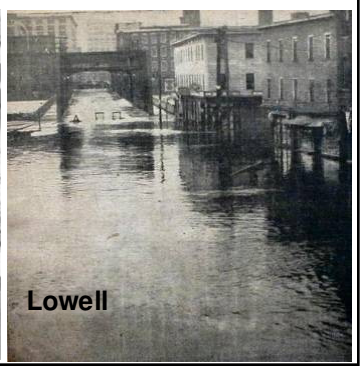


Map of Southern NJ showing locations of dikes and levees as colored circles.



And Sometimes Failed





So Congress Set the Policy

Flood Control Act of 1928- Lower Mississippi Valley
Flood Control Act of 1936 - The Nation
WRDA 1986

And Shared the Responsibilities

•…flood control is a proper activity of the Federal Government -… the Federal Government should participate if the benefits to whomsoever they accrue are in excess of the estimated costs...

•[…locals] will…

- (a) provide all lands, easements, and rights of way necessary for the construction of the project
- (b) hold and save the United States free from damages due to the constructed works;
- (c) **maintain and operate all the works** after completion in accordance with regulations prescribed by the Secretary of War
- Cost Share (86)

Levees and Other Structures Have Provided Protection to Millions of People and Saved Billions of Dollars

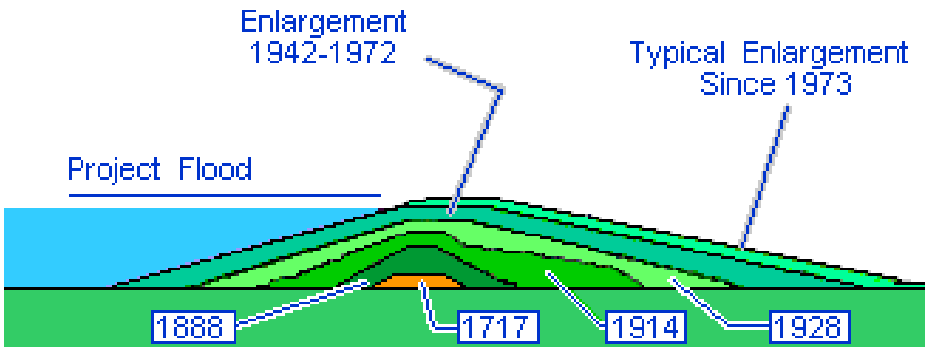
But Floodplain Development Including Levees Has Substantially Altered the Natural Environment (and Increased Risk)

Flood Protection Levels Started Strong

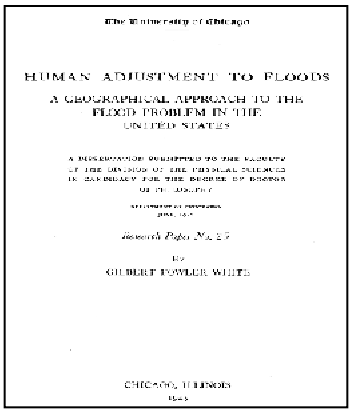
1936 -1965

500 -1000 year protection

And Levees Grew



Some Thought of Other Approaches



HUMAN ADJUSTMENT TO FLOODS

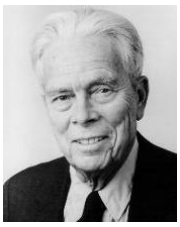
A GEOGRAPHICAL APPROACH TO THE FLOOD PROBLEM IN THE UNITED STATES

BY

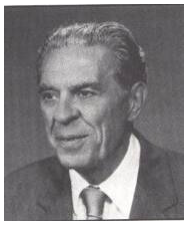
GILBERT FOWLER WHITE

CHICAGO, ILLINOIS

John Kennedy



Gilbert White



Jim Goddard

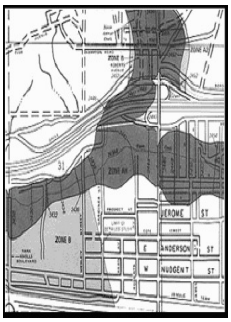
And Legislated Programs

Disaster Relief

Flood Insurance: The NFIP

The NFIP

- 1968 –National Flood Insurance Act
  - Insurance in SFHA (Mandatory for federally insured mortgages)
  - Zoning
  - 20,500 Participating Communities
- Levees in the NFIP
  - If 1% and sound, then no insurance or land controls
  - Interior drainage
  - But, many grandfathered levees
  - Process now requires "Certification" or Federal Letter (44 CFR 65.10)
  - No inspections under NFIP



Levees - Level of Protection

- June 1977, USACE to HUD:
  - "setting the design of levees in urban areas at the 100-year level could be imprudent since that is not a high degree of protection."
  - a larger flood, such as the SPF, should be adopted as the required level of protection
- September 1977, Director of FEMA Engineering Division recommended:
  - recognition (for NFIP) only levees designed to provide protection against the SPF
- 1979, USACE issued a policy memorandum
  - "On the assumption that exceedance of the design flow would cause a catastrophe, the standard project flood (SPF) is the desirable minimum level of protection that should be recommended for high levees, high floodwalls and high velocity channels in urban areas"
- In 1980, Administrator of the Flood Insurance Agency
  - recommended "…consideration of a standard in excess of the 100-year flood, such as the Standard Project Flood, for local protection works to be recognized by FEMA."
  - noted that USACE had recommended this to FIA

Levee - Level of Protection

- **1981, FEMA**
  - "the use of a 100 year standard [is] encouraging construction of levees to the 100 year design level for the sole purpose of removing an area from the special flood hazard designation"
  - Crediting a levee system with protection against the 100-year flood could violate the spirit of the National Flood Insurance Act

FEMA on Levees -1981 (1)

- Levees are involved in approximately one third of all flood disasters.
- 100-year flood is generally found to be a low design standard for structures protecting densely populated areas
- Only a fraction of all earthen levees built with crown elevations at the computed l00-year flood elevation can he expected to provide protection to the true 1 percent event because of
  - the uncertainty involved in establishing~ flood elevations
  - changing hydrologic conditions and
  - the possibility of structural failure before overtopping.

Sharing the Challenge - 1994

- **Define the responsibilities for floodplain management at each level of government**
- **Protect population centers against at least the 500 or greater year flood.**
- **Identify location and ensure adequate maintenance of flood protection structures such as levees and floodwalls -there is a levee problem.**
- **A residual flood risk remains even when permanent levees provide a high level of flood protection.**

Living with the Red - Report to the President of the US and the Prime Minister of Canada - 2000

- Urban levees are appropriate protection, provided they are evaluated systemically, are set back a reasonable distance from the river, take account of natural functions of the floodplain, and do not affect upstream or downstream flood levels.

- The Commission considers it most important that those protected by levees understand that a residual flood risk remains even when permanent levees provide a high level of flood protection. A flood that overtops the designed levee places the people and property behind the levee in jeopardy.

California

1997 - California Flood Emergency Action Team :

- In urban areas, a need exists for a higher level of levee protection than the minimum 100-year provided under the NFIP, such as 200-year or even 500-year in some areas. The 1997 flood event emphasizes that many levees (even those certfied by FEMA or USACE) did not provide the expected 100-year protection.

2005 - California DWR White Paper

- State should reduce its liability by requiring that all homes and businesses in areas at risk of flooding, regardless of the level of protection, have some form of flood insurance.
- The standard project flood should be the target flood for population centers protected by levees

Levee Liability - Paterno

- **When a public entity operates a flood control system built by someone else, it accepts liability as if it had planned and built the system.**
- **California is responsible for defects in a Yuba County levee foundation that existed when the levee was constructed by local agricultural interests in the 1930's.**
- **California may ultimately be held responsible for the structural integrity of much of the Central Valley flood control system —**

  Paterno vs. State of California
  November 2003

Levees and the NFIP Evaluation

- NFIP Accepted 100 year Levees as Removing SFHA from NFIP Restrictions
- Many Levees Entered NFIP through Grandfathering, Certification (post-1986) and Corps Programs
- Levee Performance Has Been Spotty
- NFIP Review Included Assessment of Adequacy of the 1 Percent Standard and Levee Implications

Levees, Map Mod and the NFIP

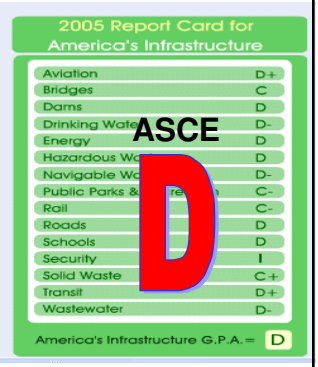
- Preliminary Map Mod Examination of Levees in the NFIP Indicated that:
  - Conditions (Integrity, Compliance) Are Not Known but Many Levees Questionable
  - No Guidance Existed on How To Deal with Questionable Levees
  - Dealing with Levees Could Delay MapMod Program
  - **Existing Standards May Not Be Up to Date (19 years old)?**
- Interagency Levee Policy Review Committee Formed to Examine Issues

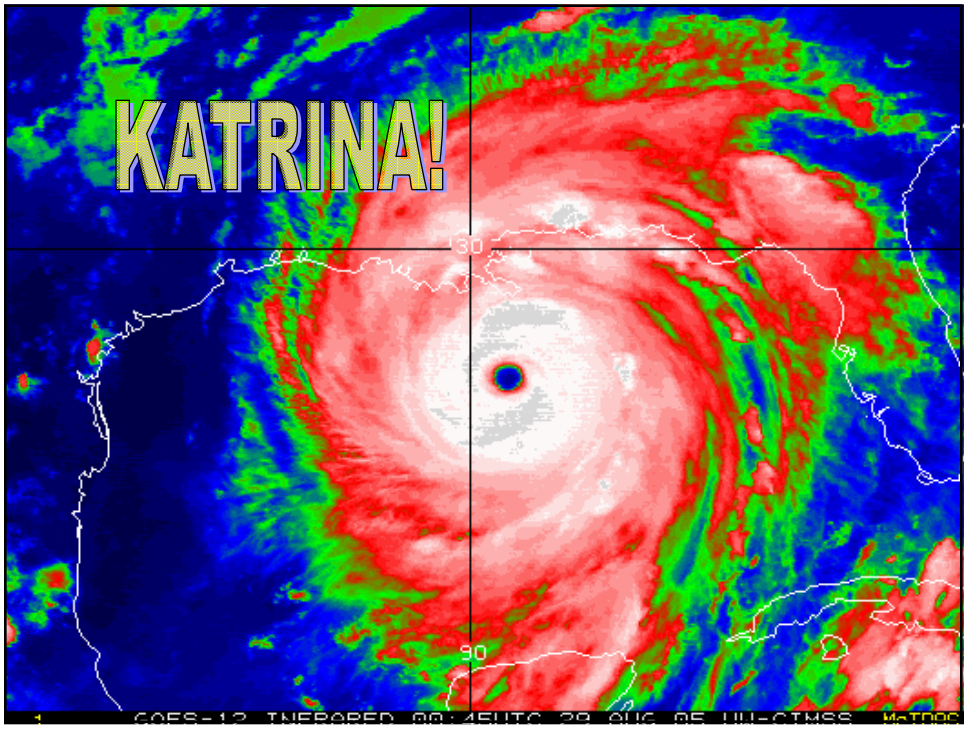
Not Maintaining and Upgrading Our Infrastructure

• Corps of Engineers [studies]… suggest that a large percentage of private or locally built levees…are or can be expected to be poorly designed and maintained (1981)

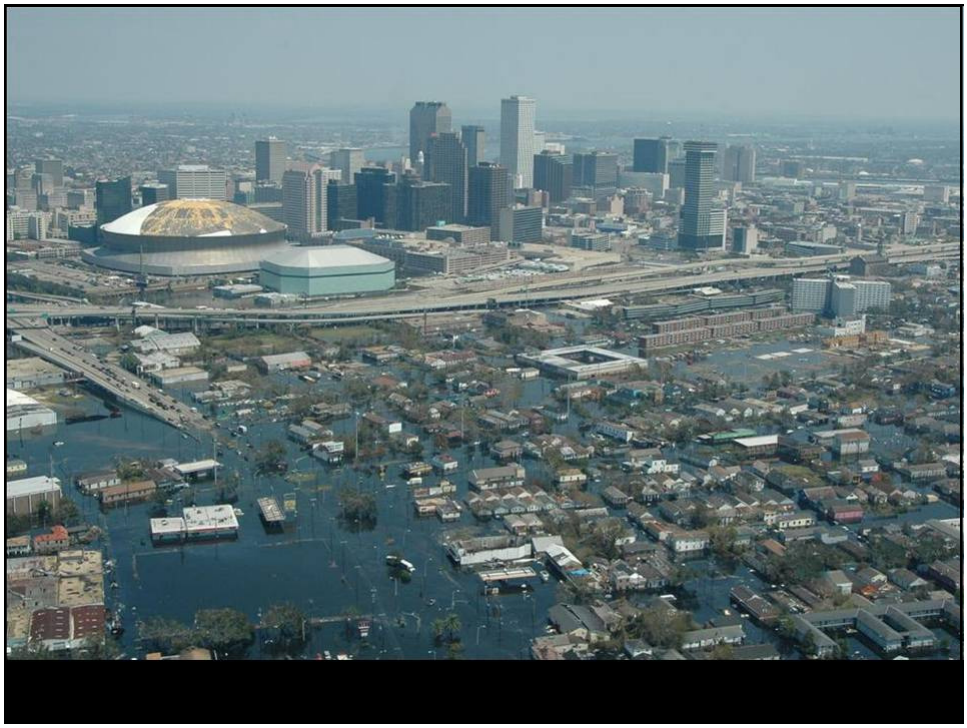
• Cannot identify location and ensure adequate maintenance of flood protection structures such as levees and floodwalls. (1994)

• Nation's infrastructure is being neglected (ASCE)



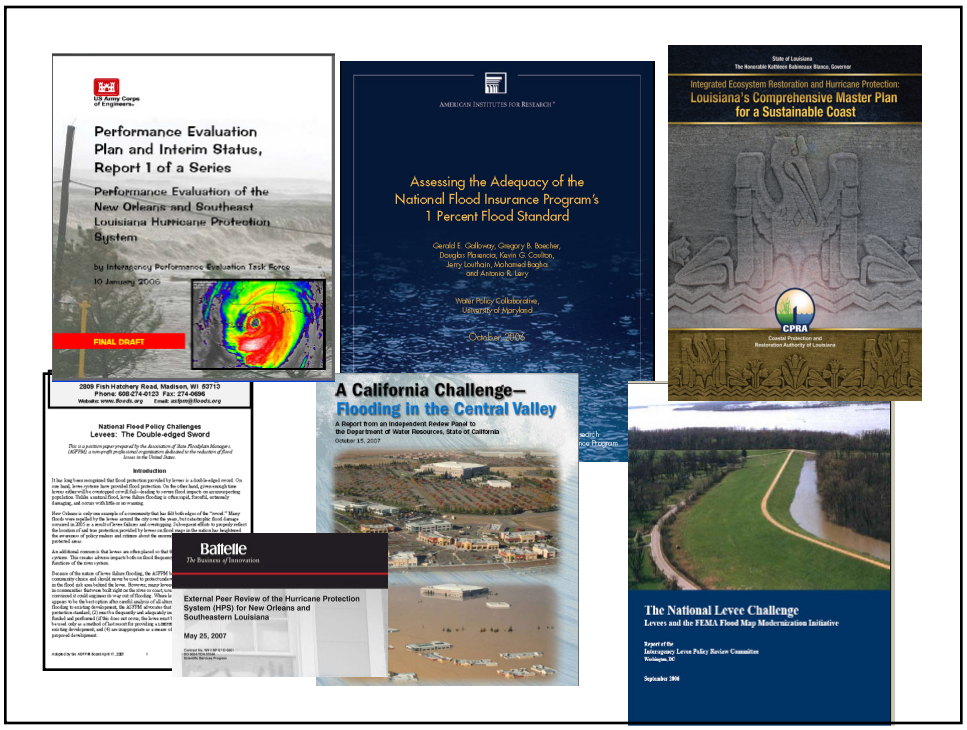


Some Levees Failed or Overtopped



- And it iwas not just New Orleans……the problem is ***National***

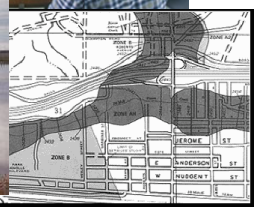

What Should We Do?


Performance Evaluation Plan and Interim Status, Report 1 of a Series
Performance Evaluation of the New Orleans and Southeast Louisiana Hurricane Protection System
FINAL DRAFT
Assessing the Adequacy of the National Flood Insurance Program's 1 Percent Flood Standard
Integrated Ecosystem Restoration and Hurricane Protection: Louisiana's Comprehensive Master Plan for a Sustainable Coast
CPRA
National Flood Policy Challenges
Levees: The Double-edged Sword
A California Challenge—
Flooding in the Central Valley
Battelle
External Peer Review of the Hurricane Protection System (HPS) for New Orleans and Southeastern Louisiana
May 25, 2007
The National Levee Challenge
Levees and the FEMA Flood Map Modernization Initiative

Flood Protection Levels: Started Strong and Finished Weak

"The present flood protection levels of all diked areas must be improved by a factor of 10. To that end, the new standards must be set as soon as possible (around 2013). In some areas where even better protection is needed, a so called *Delta Dike* concept is promising (these dikes are either so high or so wide and massive that there is virtually zero probability that the dike will suddenly and uncontrollably fail." Dutch Delta Commission Report to the Cabinet (Sep 2008).

- **Tight (Short-Term) Economics….Drove Down the Water Budget**
- **Environmental Concerns Created (Deserved?) Obstacles**
- **Cost Sharing Sought Cheapest Option**
- **and the 100-year Flood Standard Moved Us to the Lowest Common Denominator**



Levee Condition

- Levees Must Meet Prescribed Standards
  - Sound Engineering Practice
  - NFIP (Certification)
  - PL 84-99
  - Inspection of Completed Works
- Failure to Meet Standards Violates Public Trust

Levee Failure
on the Mississippi River

Improvement of Regulations Governing Levees in the NFIP

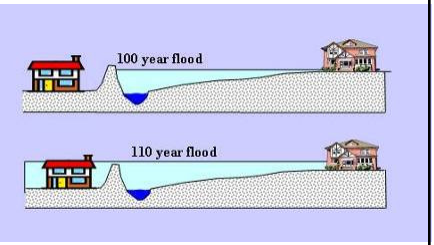
Current regulations and other guidance do not ensure that a levee meets minimum design, operation and maintenance standards and continues to meet these standards.

- FEMA should require levee sponsors, as a condition of retaining recognition of the status of levees to:
  - Conduct annual inspections
  - Biennially submit to FEMA the results of the annual inspections, operation and maintenance records, and an assessment of the levee system during any flood events
  - Every 10 years, recertify the engineering and geotechnical conditions of the levee system.
  - Certify levees as systems
- FEMA should exclude roads and railroad embankments from inclusion in accredited levee systems unless those embankments meet the engineering criteria

Identification of the Risk behind Levees

Levees only reduce the risk to individuals and structures behind them. They do not eliminate the risk.

- FEMA should define a new flood insurance zone for areas behind levees that provide 100-year protection and, in coordination with other agencies, identify the level of RESIDUAL risk to those behind those levees.
  - Potential depth of flooding
  - Density of development behind the levee
  - Steps taken to ensure that levee failure does not occur during overtopping
  - Warning times
  - Number and types of egress



Adequacy of 1 Percent Standard

- *The 1 percent standard is too low for removal of NFIP land use and insurance requirements for population centers behind levees. A 1 percent standard does not adequately take into account the residual risk behind levees.*
  - ***FEMA should not recognize levees under the NFIP unless they provide protection to the 0.2 percent (500-year flood) level.*** Levees in non urban areas should protect against the 1 percent or larger flood, depending on the economic costs and benefits of the levee.
  - ***FEMA should seek legislative authority to require mandatory purchase of flood insurance by those living behind accredited levees to address the residual risks they face and to ensure they are aware of this risk.*** Structures behind levees are subject to residual risks and should be insured against that risk.

Ensuring 21st Century Levee Design

Much of the baseline information that is used in determination of the height of the 100-year flood is out of date.

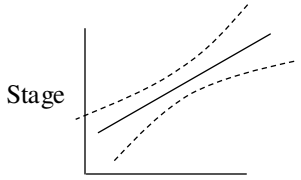
The engineering community is replacing the current levee height determination methodology required by 44 CFR 65.10 with new approaches

- FEMA, in coordination with other Federal agencies should support funding of NOAA efforts to upgrade precipitation frequency estimates, upgrades to the USGS gaging program, revision of *Bulletin 17B*,
- FEMA should modify 44 CFR 65.10 to phase out, over the next 10 years, use of the freeboard-based approach and should substitute the risk analysis methodology for levee height determination.

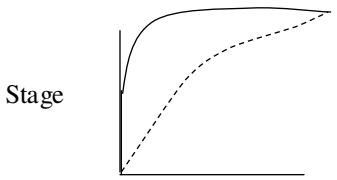
Risk Based vs Freeboard Design

Knowledge Uncertainty and Natural Variability

- Risk Based = Assurance that Levee Will Pass BFE Flood
  - Uncertainties – Stage, Discharge, Geo-technical



H&H

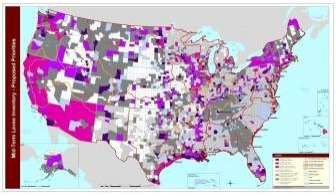


Geo-Tech

Development of a Levee Inventory

Information about the location and condition of levees across the Nation is spotty and is not in a form that supports effective management and decision making.

• FEMA and USACE should continue efforts to develop a joint database structure that will meet the needs of both agencies and other Federal and State organizations to maintain an inventory and assessment of flood damage reduction structures, including levees.



Improving Public Understanding of Levee Risks

The public and many public officials do not understand the residual risk to those living behind levees.

- Working with its Federal, State, and local partners and with levee sponsors, FEMA should develop and implement a public awareness and outreach strategy that will improve public awareness and understanding of the hazards and risks associated with levees.

Observations (1)

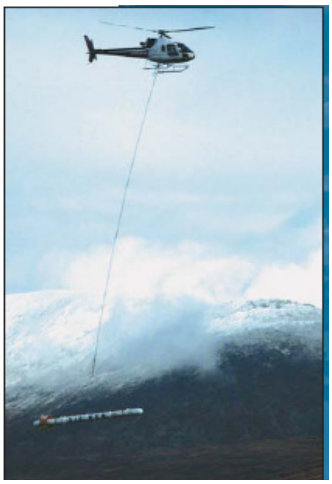
- In highly urbanized areas, strong consideration should be given to recognizing only levees that provide protection against floods greater than 100-years (e.g., the 500-year flood).
- Property owners behind levees continue to face the residual risk of flooding; FEMA should seek legislative change to require property owners to purchase some level of flood insurance for structures behind levees
- FEMA should require communities to establish special early warning systems and develop flood warning – preparedness plans for leveed areas

Observations (2)

- Federal agencies should develop incentives and support mechanisms to ensure that State and local agencies can effectively carry out their responsibilities.
- FEMA, working closely with other Federal agencies, States and communities, should examine how best to deal with climate change, sea-level rise, and future development in computation of BFE
- FEMA should take action to improve the implementation of the 1 percent standard for regulation of land use**.** Such actions as enhancement of public understanding of hazards, use of future-conditions hydrology to account for urbanization and climate change, reduction in floodway infringements, and greater attention to enforcement of existing NFIP provisions would greatly improve the effectiveness of NFIP related land use decisions.

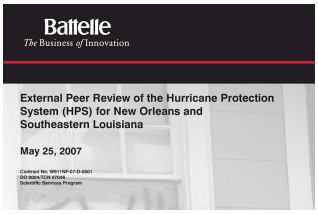
Observations (3)

- FEMA, USACE and USGS should support R&D efforts focused on improvement of rapid assessment of levee geotechnical integrity and should jointly recommend to the National Science Foundation that attention be given to this area of research.



Observations

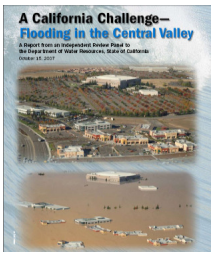
1. Provision of risk reduction (protection) against the 100-year annual chance (100-year) event is not sufficient to prevent possible loss of life and social disruption in a major urban area.
    - There is a 26% chance of the occurrence of such an event with the life of a 30-year mortgage. Recent national studies indicate that urban areas need a higher level of protection.
    - Providing 100-year protection may make it difficult to subsequently provide a higher level of protection.



Slide 50

Recommendations

- Provide the highest level of risk reduction feasible to existing urban areas where thousands of people are at unacceptably high risk.
  - Develop an implementation plan 200-year protection by 2020, and Standard Project Flood protection by 2030**
- In less populated areas, provide protection against less severe floods (e.g. less than 200-year protection) as economically and environmentally justified, *and, through appropriate compensation, maintain that lower level of protection into the future.*



Recommendations - 2

- Manage the floodplain by focusing new development outside of the floodplain or in low-risk locations within protected areas of the floodplain, supporting the use of undeveloped and unprotected land for agriculture and other low-intensity land uses.
- Accompany floodplain management with requirements for local governments to adopt *and enforce* needed land-use controls, financial and technical support to enable them to do so, and appropriate penalties if local governments fail to manage development to reduce flood risk.

Recommendations - 3

- Site, where feasible, new levees or major rehabilitation of levees at a distance from the river and from existing levees.
- Ensure that any flood protection provided is sustainable fiscally and physically over time.
- Mitigate potential financial losses to those behind levees and to those in the non-leveed 500-year floodplain shown on FEMA flood maps through institution of mandatory purchase of flood insurance, or through inclusion of flood insurance in homeowners' policies of those within these areas.
- Share the liability for flood damages among state and local governments.
- Communicate to the public and each property owner in the floodplain the specific risks of occupying areas at risk of flooding, and provide steps property owners can take to reduce their exposure to flood damages.

Recommendations - 4

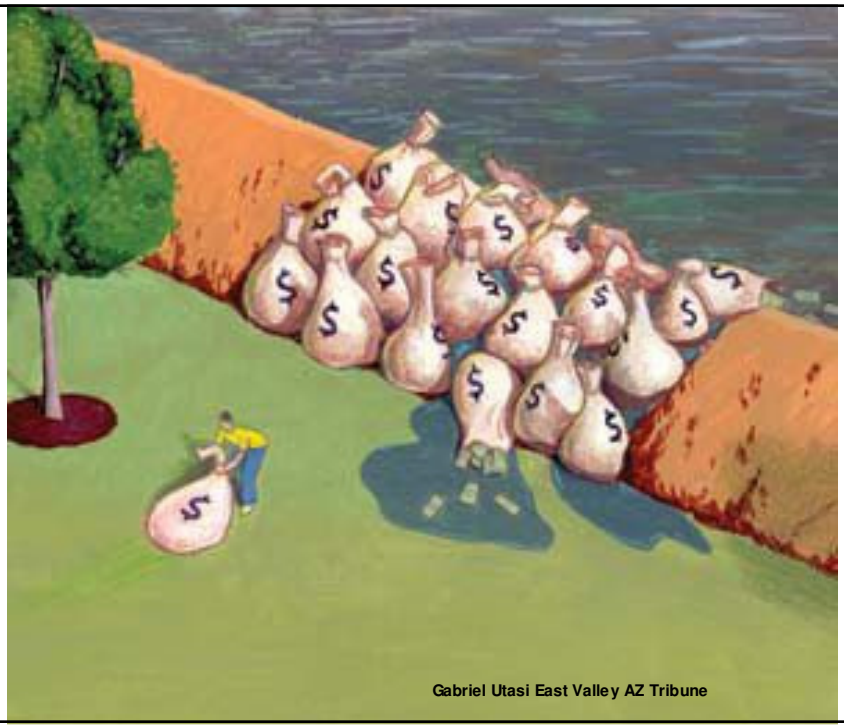
- Supplement the structural protection provided with floodproofing, elevation of homes and businesses, land-use regulations, and other non-structural approaches to reduce the residual risk that will continue to exist
- Work together with the development, environmental, and business communities, and with citizens.
  - Outreach and coordination with these groups is vital to the success of any floodplain management program for the Central Valley.
  - Consider formation of a Task Force comprised of local elected officials, developers, and environmental stakeholders to work with the state to develop an acceptable approach to implement these recommendations over the most expedient timeframe possible

Interim Levee Guidance – Procedure Memorandum 34

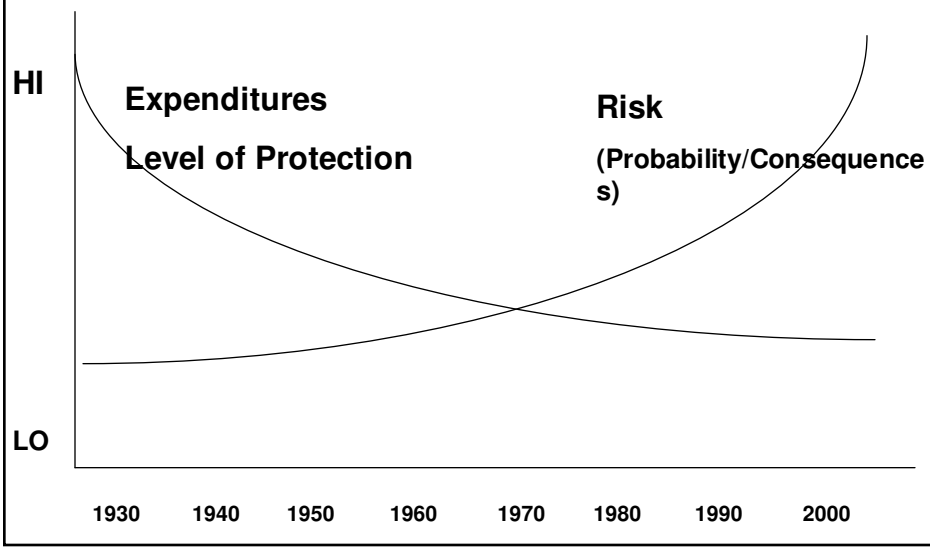
- Require the community or party seeking recognition of levee system to provide required (certification) data.
- Continue to recognize levees only where prior certification can be located (or new certification provided), documentation of adequate maintenance is in hand, and BFEs are not changing.

Interim Levee Guidance – Procedure Memorandum 43

- When levee does not meet standards, levee is removed from program
- If certification information is not readily available and levee appears to be satisfactory, provisionally accredit levee and give community two years to gather data



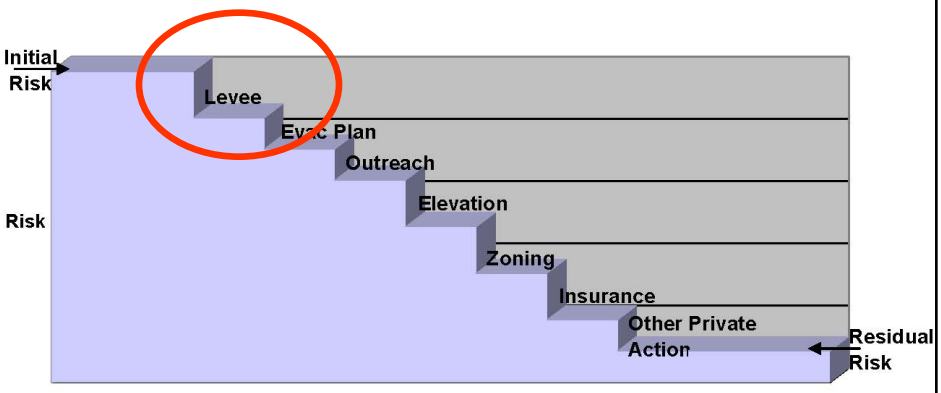
Losing Sight of the Mission



History Tells Us:

- Levee Problems Are Not New
- Solving Levee Problems Requires a New Approach
  - Every level of government and the public must play a role and assume their responsibilities –need Policy
  - Adequate funding must be provided
  - Levees must be used responsibly
  - Must plan for future conditions
  - Levees are only part of overall flood risk reduction –nonstrucutural matters

But..the Bottom Line



Risk Reduction Tools (Cumulative)
Figure 2

Comment

The committee recognizes that the recommendations and observations it has offered will require significant resource commitments at both the federal and state level. In a period of intense pressure on budgets, such proposals will certainly not be well received.

The issue, in reality, is one of "pay me now or pay me later". The harsh truth about levees is their potential for eventual failure and it is incumbent on those in responsible positions to argue forcefully for dealing with those issues now, when the costs will be far less than they might be in the future when another Katrina occurs.

Floods are an act of God; flood damages result from acts of men.

House Document 465, 89th Congress, 2d Session:

A Unified National Program for Managing Flood Losses, August 1966


Thank You